An artificial intelligence powered direct prediction model of machine parameters to enhance patient specific pre-treatment during radiation therapy

Unmet Need

Intensity modulated radiation therapy (IMRT) and volumetric modulated radiation therapy (VMAT) are commonly used radiation therapy techniques that are characterized by their highly conformal dose distributions and require pre-treatment quality assurance to ensure accurate delivery. However, standard pre-treatment quality assurance measurements are time-intensive, inefficient, and, importantly, are poor detectors of problematic radiotherapy plans. “Virtual” pre-treatment QA techniques have recently been proposed which use artificial intelligence to predict the results of pre-treatment QA measurements, however these algorithms do not provide sufficient information to translate the QA results to the patient geometry and thus do not improve upon the detectability of the original QA technique. There is an unmet clinical need for an efficient pre-treatment quality assurance technique that is better able to detect problematic IMRT and VMAT treatment plans.

Technology

Duke inventors have developed an artificial intelligence powered prediction model that directly predicts the machine parameters at treatment delivery, and thus can be used to quantify dosimetric effects on the patient anatomy. The artificial intelligence model is trained using linear accelerator trajectory files from prior patients, and the model can be updated on an ongoing basis using the most recent trajectory files to account for changes in machine performance. The model can also incorporate uncertainties in multileaf

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Publication(s)

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External Link(s)

• From the lab of Dr. Justus Adamson

collimator position accuracy as measured during routine QA, to account for any multi-leaf collimator errors not accounted for by the linear accelerator trajectory file. A working prototype of the prediction model has been developed which accurately predicts the linear accelerator mechanical parameters and dosimetric effect on the patient anatomy, when compared to the post-treatment trajectory files.

Virtual patient specific QA workflow

Advantages

- Compatible with online adaptive radiotherapy
- Provides direct feedback regarding the clinical dosimetric effect
- Prediction model can be easily validated for each prediction after the first (and each subsequent) fraction by comparison with the trajectory log file
- Dovetails with existing log file analysis and sophisticated independent dose calculation QA strategies